MDB GIS, on a new concept regarding the computerization of the mining activity

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Key words: Mining data bank Geographic Information System, Database, 3D + Time + Continuum Dynamic

SUMMARY

The imminent shortage of raw materials will lead to a reconsideration of the potential of preserved mines and will lead to reopening of activity; from the beginning management must be based on information structured in the form of databases. This paper aims to present a general concept regarding the establishment of adaptable and reconfigurable mining data banks which would represent a first step towards new conceptual guidelines on the management of the mine.

MDB GIS (Mining Data Bank Geographical Information System) concept develops the better known MGIS (MiningGIS), a relatively new concept that precisely addresses the issue of mining computerization, having two layers of reference: the general plan of the mine, for underground and the surface topography plan of the mine. All data entered into the system are geo-referenced. MDB GIS retains these advantages but develops the information system by including specialized software on production management, the financial and accounting records of the work, the design, planning and coordination of production. MDB GIS is intended as a modern, complete, modular CD + 4D (3D + Time + Continuum Dynamic) means of management of mining activity, based on a GIS platform, entering all data geo-referenced into a given cartographic system, adaptive through modulation, with possibilities of implementation in stages. This paper aims to present this new concept in the author's view, with the hopes of restarting the mining activity, especially in Romania. MDB GIS on a new concept is intended as a modern, complete, modular CD + 4D (3D + Time + Continuum Dynamic) means of management of mining industry, based on a GIS platform, regarding the computerization of the mining activity.

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1. INTRODUCTION

The imminent shortage of raw materials will lead to a reconsideration of the potential of preserved mines and will lead to reopening of activity; from the beginning management must be based on information structured in the form of databases. Compared to the previous analysis of data banks it can be said that GIS is the most modern territorial database being the current management concept in running any organization. That is why the author believes that research should focus on defining a new concept for creating mining databases on the analysis, configuration, definition and customization of GIS databases, for mining, given that information comes from an organization, and the systematization of data as a database is aimed at a better view of all relevant information on the organization's activities. This makes the establishment of the current relation between information in the field of mining and the Geographical Information System-GIS, and the ways of integrating data from the mining field into the GIS, crucial. Currently, no industrial sector can progress without a management system based increasingly on the computerization of business and its management and coordination. As the leader of the world's economy, the extractive mining industry cannot be an exception to this rule in any part of it, from the exploration phase to the delivery of extracted materials to processing industries. One can see that the largest mining companies use specialized software for certain activities, that very few companies have implemented a GIS system, including only some activities, that there is mining software, some very powerful and widely recognized by major companies in the industry and that, at conceptual level, large GIS software manufacturers are prepared to enter the mining market, to the extent that it is ready for major changes in organization management. The degree of computerization of mining companies is extremely varied from mine to mine, but the before mentioned transnational nature of the extractive industry paradoxically makes some mines in Africa, Senegal, Ghana, South Africa, Botswana or Latin America, Chile, Peru to have a higher rate of computerization compared to mining organizations in countries with a centuries old mining activity like the ones in Europe. The computerization ways are different, with some companies opting for mining software, others developing GIS platforms. Others, very rare, have combined the two methods and most have developed custom general software, tailored for the field. Analyzing these methods of computerization the question arises: is it possible to link all or most of these computerization methods in the mining activity, and if so, can we create a model, a modular concept, adaptable to any condition, any mode of operation, any raw material? One may find, as I have said before, that the largest mining companies use software specialized for certain activities, that very few companies have implemented a GIS computer system, including only some activities, that there is specialized software for mining activities, some very powerful and widely recognized by large companies in the field, and that, at a conceptual level, the big GIS software manufacturers are prepared to enter the mining market, to the extent that it is ready for major changes in organizational management. The most complete mining computer system was designed by IBM (Indian Bureau of Mines) at the order of the Indian government, originally entitled Mineral Information System (MIS), supplemented subsequently and renamed Technical Management & Information System (TMIS) which contains a number of databases among which GIS. Niche information systems in mining or in complementary areas were created and work very well, for example in geologly there is GeoGRAFX GDMS, in mining the Mining Information System, created by Trimble, the general mining software AVIS - Old mining management and information system, created in the German land of Brandenburg, but the most complete databases were developed in the field of environmental protection at the action of pollutant factors of mining origin, Mine Environmental GIS - MEGIS, which appeared in China or Environmental Information System - ENVIS from India. There were public exposures, through the web, of databases such as Web-Based Geotechnical GIS developed and implemented by the Alabama Department of Transportation. Strictly referring to mining management, the Mining Information System creations produced by the Australian software company MininGIS, through its two components, namely Mine Management Reporting System MMRS and Workforce Reporting System WMRS, distinguish themselves through their complexity and success acquired immediately after launch, having been bought by the largest multinational mining corporations in the world.

2. THE MDB GIS CONCEPT

The new concept of MDB GIS mining databases (MINING DATA BANK GIS) is a summary of the author's view on data making up the 'life" of a mining company, the way it collects, selects, handles, manages, updates in order to computerize its activity as much as possible, in a permanent action and desire for efficient management. The new concept, according to the author, is **modulated** starting from a **trunk** which defines the initiated information system in minimalist terms. The system will allow the addition of **an infinite number of modules** at the "data" level, relational" level, "programs-software applications", "processing equipment", but also at the level of the components in the "database management system" and last but not least at the "users" level.
In the **MDB GIS** design the author has included:

1. Databases,
2. The general operating platform which is GIS,
3. The general rectangular coordinate system in which it operates, **GSRC (Generalized System of Rectangular Coordinates)**,
4. The GSRC integration and georeferencing system in **4D + DS (3D + Time + Dynamic Simulation)** of all data entered into MDB GIS,
5. The general operating and computing system,
6. The general link system of all networks,
7. Processing equipment,
8. Database management system,
9. Software applications,
10. System users.

The whole system can be managed as "**web applications with databases**" by creating a professional website entitled www.mdbgis.ro in which the entire information system can be accessed. **The geospatial solution**, basic idea of the **MDB GIS** concept of georeferencing all information entered into the system, is the skeleton upon which specialized interfaces shall be developed for data loading / consultation and loading / association from existing applications. This solution is the first step in a process in which all administrative sectors of the unit will contribute with local information to the central database, creating all the prerequisites for an objective justification of decisions regarding short-term, medium-term and long-term strategies for spatial development of the mining institution. The result is a system which provides geospatial data collection from several perspectives, processing and organizing thereof into a single **database** and provides georeferenced information in a centralized way that represents the basis for making the most appropriate decisions in terms of realistic management for mining.

Project objectives:

- Creating a unified information system to automate all daily work flows which involves accessing or generating geospatial information across the whole institution,
- Unifying all data managed by the mining institution in a single database, called **Mining Data Bank Geografical Informational System (BDG SIG-MDB GIS), in short MDB GIS**.
- Creating a correct and updated information support to facilitate rapid and informed decisions in the strategic management of the institution.

3. PURPOSE, SCOPE

MDB GIS will be a Geospatial Data Bank (BDG), the geospatial component of an integrated information system for an entire mining institution. At the end of implementation, **MDB GIS** will exceed, through scope and complexity, the initial requirements. Thus, through specialized applications, hundreds of users will be able to access and manage geospatial information within a virtually infinite number of distinct workflows. In building **MDB GIS** I followed these steps:

- I have determined the distribution of information in the created system (Fig. 2),
- I have identified the **Sources of information, actors involved and the meaning of links created in the Mining Data Bank Geographical Information System**, **MDB GIS** (Fig. 3),
- I have established the structure of research in the **Mining Data Bank Geographical Information System, MDB GIS** configuration (Fig. 4).

A new computer system was created, defined in the paper and called **Mining Data Bank Geographical Information System MDB GIS**. Creating a mining database, specifically a new concept of mining database, the already defined **MDB GIS** was an undertaking requiring completion of specified stages in Figure 4. The four stages also represent the logistics of configuring the thesis into chapters, the eight chapters of the thesis fitting thematically into the four groups of issues defined in Figure 4. An important statement should be made here: the MDB GIS mining database will have two meanings, the first being the general theme of the thesis: a database concept in which the structure, components, the organizational implementation strategy, modularity, etc. are interesting; the second, related to the content of the data bank, named software, information on mining computerization, centralized and presented unified, strategies and steps in the construction of the base.

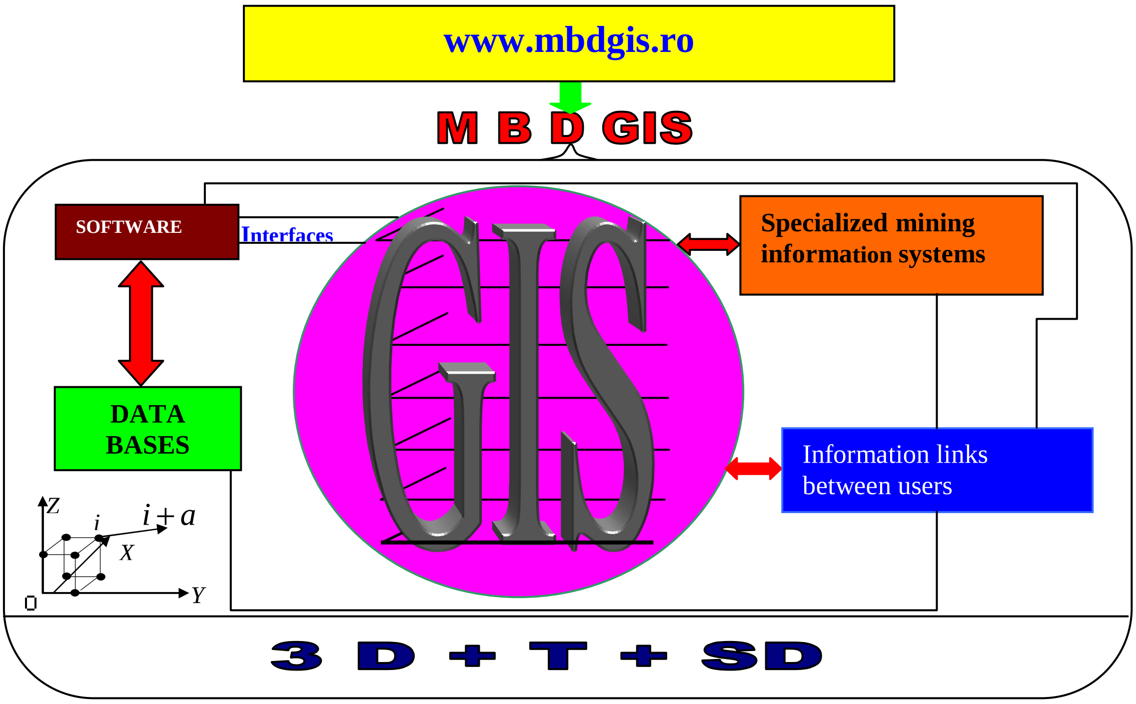

Fig. 1. Mining Data Bank Geographical Informational System (MDB GIS) components

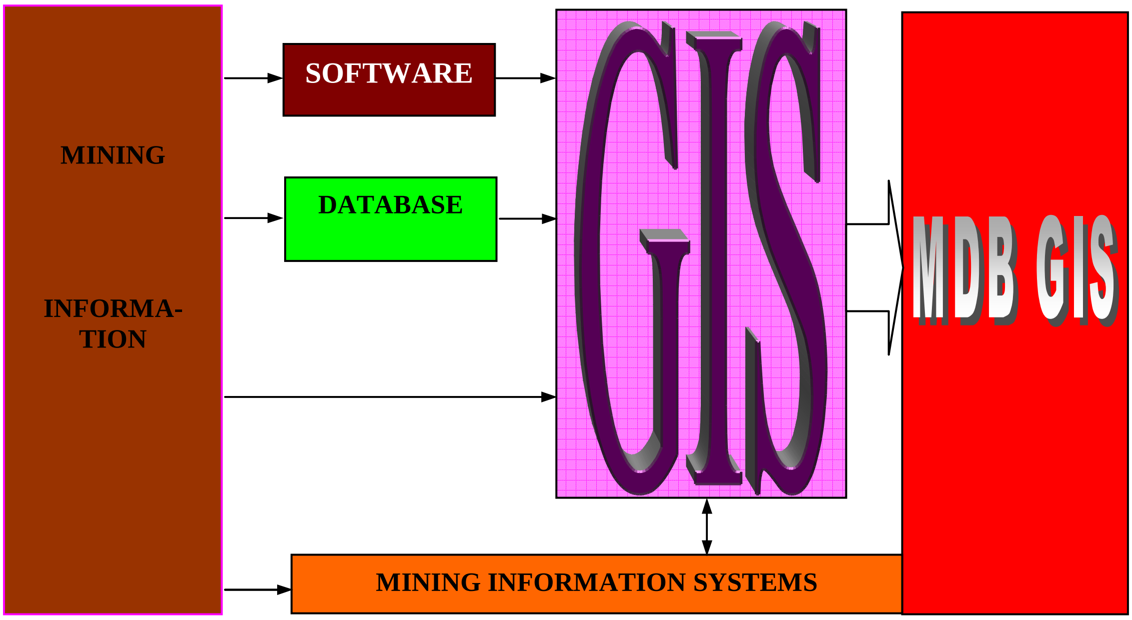

Fig. 2. Distribution of information in Mining Data Bank Geographical Informational SystemMDB GIS

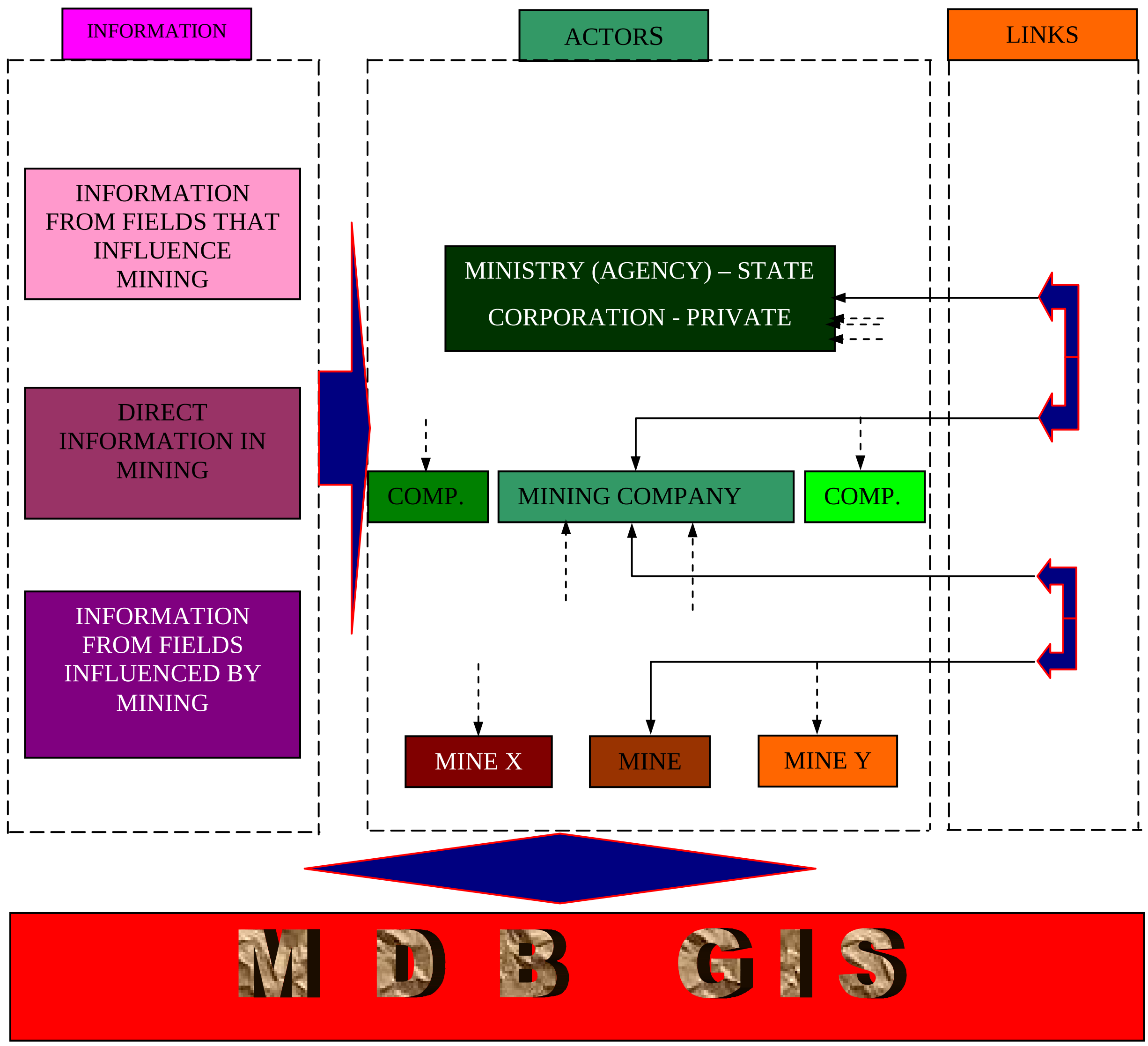

Fig. 3. Sources of information, actors involved and the meaning of links created in the Mining Data Bank Geographical Informational System (MDB GIS)

3. STAGES OF MBD GIS IMPLEMENTATION IN AN ORGANIZATION

A. Preparation

1. Identifying actors and hierarchies. For simplicity I will use the current Romanian system, naming the actors agency, company, mine, with descending hierarchy.
2. Identification of internal compartments, organizational chart, for each actor
3. Configuring network topology, establishing computer links between actors, data changed and / or entered into the system
4. Identification of internal information from the agency, referring to the company's activity, the mine respectively

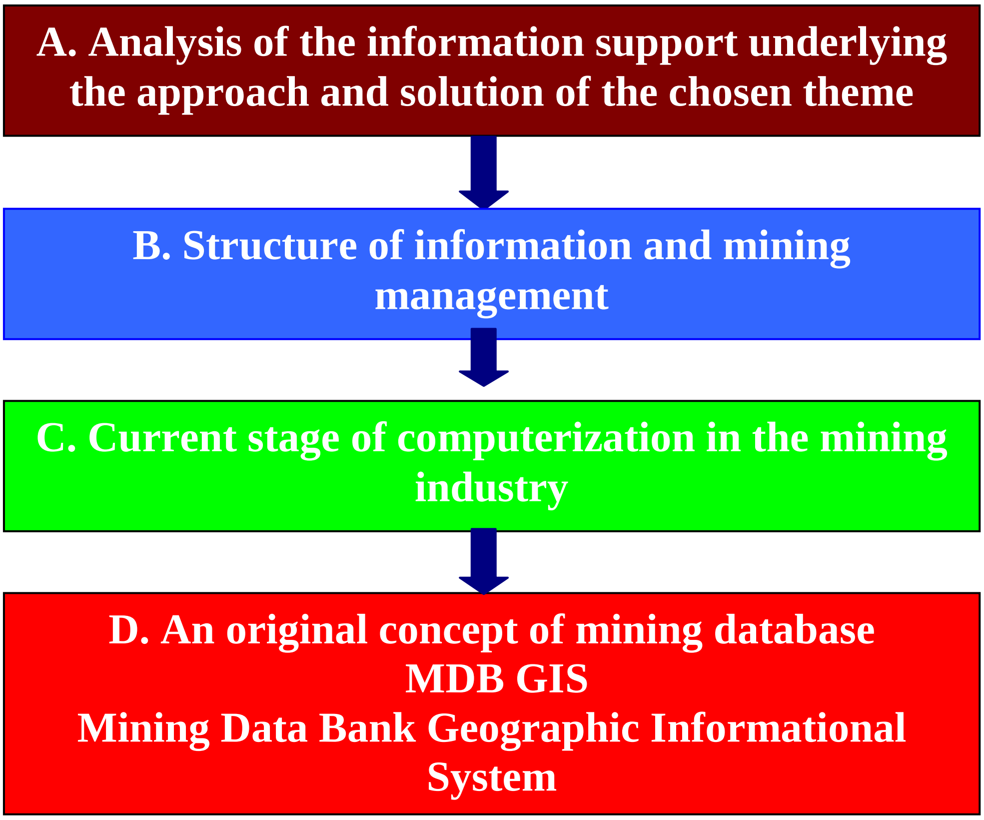

Fig. 4. Structuring of research in the Mining Data Bank Geografical Informational System (MDB GIS) configuration

5. Identification of internal company information, with reference to mine activity
6. Identification of internal mine information
7. Establishing requirements of computerization and the order of implementation for all information in the system. They will form according to the models presented, tables and graphs, databases; software will be acquired and the main software version will be purchased for initial GIS setup, then for MGIS.
8. Distribution of data on computer management destinations: Databases, GIS Layers, Attribute data.

B. Procurement

9. Configuration (acquisition) of a computer network, external hard drives, which will manage the system
10. Purchase and installation of efficient general operating software
11. Purchase of a powerful SGBD software, or similar, for management of databases
12. Purchase of a powerful GIS software
13. Purchase of a powerful CAD software
14. Purchase of a powerful ERP software
15. Purchase of a powerful MINING software, like Vulcan, Surpac.

Notes: These **stages** (1-15) are **mandatory** to configure the **MDB GIS** system.

16. Purchase of general software with possible applications in the mining industry or other software designed for this field.

C. Setup and loading MBD GIS with data

17. Creating a web in the www.mbdgis.ro category, common communication platform between all actors involved in mining, with general access passwords, or / and for section and / or information, data, layers, etc.
18. Preparing the general operating system, the computer network, external hard drives, checking the system's capacity to receive all information to be loaded later
19. Installation of general operating software
20. Installation of GIS, SGBD software, and other complementary software required to manage MBD GIS
21. Introduction / creation of basic information floors in GIS, **LTOP010, LTOP012, LVER001, LVER002**
22. Introduction of topographical and cadastral graphic data, planning and construction data from adjacent areas in Tables 5.8.CAD, 5.9.URB and 5.10UTI, configuring the URBAN GIS of the area, optional stage, may occur after stage 19. Stages 21, 22 may be conducted simultaneously, first 21, then 22 or vice versa, on an Urban GIS made by system reconfiguration through the introduction of the four basic layers.
23. **MGIS** configuration, by introducing in GIS the topographic documentation from Table 5.1.TOP, geological doc. from table 5.2.GEO, mining doc. from table 5.3.MIN, surface mining, 5.4.sup
24. **MGIS** completion by entering the other data listed in Tables 5.4.FIN, 5.5.MRU, 5.7.MED and 5.11.CLI
25. Stage parallel with stages 18-21, creation of databases
26. Setting the attributes of each layer of **MGIS**
27. The introduction of attributes in **MGIS**, establishing the internal link and / or
28. Allocation of databases in **MGIS**
29. Introducing in **MBD GIS** the software with mining purpose interfaced GIS
30. Introduction in **MBD GIS** the software with mining purpose non-interfaced GIS and establishing interoperable software-GIS connections.

Note: Each stage will be accompanied by checks, tests, inquiries, transfers of data between different actors, etc.

Although the general **MBD GIS** configuration (design) will remain intact throughout the use, the content is continuously variable, the lowest step of updating being a few seconds, depending on how the sensors that acquire data from the underground are programmed regarding, for example, air quality. There will be databases / layers / attributes that will change rarely or never, for example the passport of the deposit or the status of the business will rarely change, but, for example: horizon plans – often, the position of stages on mining receptions - very often, the daily records of employees and data with quasi-continuous or continuous variation – very often. For this reason it becomes necessary to allocate time to each data acquisition, together with the time of display / query. A display system, which I call the **Brand of the queried date**, shall be used, as stated in Table 1.

Tabel 1. Brand of the queried date (source: author)

Layer	Date of recording						Date of query*					
	Hour	Min	Sec	Day	Month	Year	Hour	Min	Sec	Day	Month	Year
LTOP0034	08	45	12	07	10	2012	10	22	34	23	11	2012

* Start time of the information analysis.

The brand of the queried date will appear in the header of any document, paper, analysis issued after consulting the information / data provided by the date, layer, database accessed, etc. In this way, the actuality of information is ensured, the brand certifying that the latest document in the queried category was consulted (generally data from the nearest past is requested).

CONCLUSIONS

I believe that from the foregoing analysis and presentations results much of the benefits of MGIS and of the management process that may rely on it as a leading provider of information, compared with traditional management methods based largely on the analysis of written reports.

I think the biggest advantage offered is the possibility of viewing virtually any information in a graphically digital manner, and then the possibility of simulation and study of the alleged situation's effects. Another huge advantage is the actuality of data, if the system is working properly, because information can be analyzed after a few moments from running it. In case of underground accidents, knowledge of the effects, if the MGIS system is doubled by a sensory system monitoring the processes and activities underground, can be made spontaneously, and the system will provide the most current and complete information on the organization and coordination of the emergency situation. But, by currently using MGIS, we do not have to reach such events as the system provides sufficient data to prevent them.

The biggest gain will be for the daily activity of all those using the information in the current activity, from sector heads to the unit manager, not to mention the managers of upper structures who will be able to oversee the entire activity of all subordinate institutions from their offices.

Another big advantage is the possibility of having synchronous data for important information regarding: state of underground railway, air, gases, dust, water infiltration, situation of perforations and directed explosions, operation of machinery, mining machine, and many other events, obviously depending on the equipment and specific of each mine, but also in relation to the possibilities and willingness to invest in monitoring the underground mining environment.

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